U. S. FOREST SERVICE

RESEARCH NOTE LS-12

LAKE STATES FOREST EXPERIMENT STATION • U. S. DEPARTMENT OF AGRICULTURE

Cordwood Heights of Mixed Oak Growing on Grayling and Rubicon Soils

Mixed stands of oak growing on glacial drift of deep coarse sand occupy about 2 million acres of former pine lands in the central portion of the Lake States. These soils, which have a low water-holding capacity, are poor for oak growth, and the principal timber products being produced are pulpwood and pallet stock material. Extensive soil series commonly associated with these poor-quality oak stands include the well-drained Podzols and Brown Podzolic sands such as Grayling,[1] Rubicon, and Graycalm sands — all of which have no texturally developed *B* horizon. This paper presents cordwood heights for oak on these soils by d.b.h. (tree diameter at breast height). These heights can be used for determining volumes from diameter tallies on timber cruises and other forest sampling work.

The cordwood height—d.b.h. data were obtained from a study underway on the growth of nine mixed oak stands growing on Grayling and Rubicon sands located in five different counties of northern Lower Michigan. The number of 8-foot bolts to a 4-inch usable top in each tree 5 inches or more in d.b.h. was obtained for a 1,000-tree sample. About two-thirds of these trees were growing on Grayling and one-third on Rubicon sand.[2]

The oak species occurring in the stands studied were white oak (*Quercus alba* L.) and oaks in the red and black oak group which are not easily identified by species in this latitude because of overlapping leaf, acorn, and other tree characteristics. They include northern pin oak (*Q. ellipsoidalis* E. J. Hill), black oak (*Q. velutina* Lam.), red oak (*Q. rubra* L.), and possibly scarlet oak (*Q. coccinea* Muenchk.). A working term name for them might be "other oak" or "ellipsoidalis complex" until more precise taxonomic investigations are made. The oak species were about equally divided between the white and other oaks. Other trees that were found in scattered numbers include aspen (*Populus tremuloides* Michx. and *P. grandidentata* Michx.), red maple (*Acer rubrum* L.), and jack pine (*Pinus banksiana* Lamb.). The stands were relatively even-aged, ranging from about 50 to 65 years. Diameters ranged from 1 to 14 inches, with an occasional oak 16 to 20 inches. Basal area densities ranged from about 50 to 80 square feet per acre.

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[1] *Grayling sand is a well-drained Brown Podzolic soil developed in deep sand with a very thin grayish brown leached horizon (A_2), a yellowish brown subsoil (B_{ir}), and a pale brown sand C horizon. Rubicon sand is a well-drained Podzol with 2 to 10 inches of a light gray horizon (A_2), a dark brown subsoil horizon (B_{hir}), and pale brown sand C horizon. Graycalm is similar to Grayling except for thin ½- to 1-inch bands of loamy sand below 42 inches. The relationships of these soils to others in this region are described in "Soils of the North Central Region of the United States." No. Cent. Region. Pub. 76, and Univ. Wis. Agri. Expt. Sta. Bul. 544. 1960.*

[2] *The soil under each sample stand was identified by Dr. E. P. Whiteside, Soil Science Department, Michigan State University, East Lansing, Mich.*

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The number of 8-foot bolts in relation to d.b.h. was fitted best with a quadratic equation of the form $Y = a + b\,(d.b.h) + c\,(d.b.h.)^2$ for both oak species and soil types. Differences in the regression estimates of cordwood heights between the various oak species on both Grayling and Rubicon were generally less than 0.5 bolt with a maximum of 0.6. The maximum predicted difference in cordwood heights in terms of cordwood volume amounted to less than .01 cord per tree for oak up to 11 inches at d.b.h. and .02 cord per tree for trees 11 inches at d.b.h. and larger. This finding suggests that one combined cordwood height-d.b.h. curve has considerable practical value for determining stand volumes of mixed oak growing on the Grayling-Rubicon association as presented in table 1. Local d.b.h. volume tables may be prepared as shown for the cordwood volumes in column 3 of table 1 or cordwood volume-basal area ratios for point sampling as shown in column 4. The cordwood volume-basal area ratio averaged 0.21 for the mixed oak stands used in this study. This basal area included only trees supporting cordwood volumes.

The cordwood heights in table 1 were field checked for their accuracy in 12 additional mixed oak stands growing in northern Lower Michigan on coarse sandy soils having no textural *B* horizon. The soil type in five of these stands was later identified as Grayling sand; in the other seven it was a Graycalm sand. In each test stand cordwood height was measured for the first tree of each of the following diameters: 6.0, 8.0, 10.0, 12.0, and 14.0 inches. The average deviations of the test trees at any one d.b.h. did not exceed 0.3 bolt from the predicted heights in table 1, which was well within the desired degree of accuracy.

TABLE 1. — *Cordwood height and volume of mixed oak on Grayling and Rubicon sands, by diameter at breast height*

Diameter at breast height (inches)	No. of 8-foot bolts[1]	Cords per tree[2]	Cords per sq. ft. basal area[3]
5	1.3	0.013	0.010
6	2.0	.027	.138
7	2.6	.045	.169
8	3.2	.068	.195
9	3.8	.100	.226
10	4.2	.131	.240
11	4.6	.171	.259
12	5.0	.214	.273
13	5.2	.262	.284
14	5.4	.311	.291
15	5.6	.372	.303

[1] $Y = -3.372 + 1.090\,(d.b.h.) - .033\,(d.b.h.)^2$, $R = +.89$, $N = 1,057$.

[2] *Composite Volume Tables for Timber and Their Application in the Lake States, by S. R. Gevorkiantz and L. P. Olsen, U. S. Dept. Agri. Tech. Bul. 1104. 1955. Table 6 (corrected to 19 percent bark volume for oak).*

[3] *Ratio of cords per tree (from Column 3) to square feet of basal area for point sample cruising. To obtain cords for individual trees or for stand volumes multiply the square feet of basal area by the appropriate ratio computed for the various tree sizes.*

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